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LAST MEETING

Mike Goldstein brought his home-brew solid state rcvr with digital frequency readout and discussed it's development. He referred to three articles which he wrote for the Radio Handbook (West coast) and recommended the book for the serious experimenter since it goes a step farther than the ARRL handbook,

NEXT MEETING Tues. ~~8~~ 7.00 p.m. April 9 OSHAWA POLICE STATION

Note the time and place of meeting. We are going on a tour of the new station so be there promptly or you will miss it. Hams often find themselves working with the police in emergency work and this tour will let us see how the new Durham Regional Force works.

2 FM

Touchtone functions have been expanded to include switching over the transmitters. We have a search lock working now so that both 720 and 400 will access the repeater. Either one can be shut down by touchtone but this is a control function and not an operational one. There is a small bug in the works which Mike is working on so you may hear the odd squawk. If you haven't ordered crystals yet there is a source in the U.S. with a fair price and good delivery. It is ...

K.W. Industries Ltd., P.O. Box 508, Prague, Okla 74864

The new Owen Sound repeater, 3OSR had a visitor. Mike, 3FIV strapped a few connections on the old RPT rig there and made it work better. Jack, 3DTS is one of the principals and is also secretary of the Owen Sound Radio Club. They had a good write-up in The Ontario Amateur. OSH crystals are not going to be delivered before June.

LIGHTNING: COMPLEXITY, MYSTERY, DANGER

This highly informative article explains some of the phenomena associated with lightning — a timely subject, since the month of May marks the beginning of the thunderstorm season in parts of the U.S. and other countries

- taken from Electronics Digest May/June 1972 through the courtesy of Westinghouse Electric Corporation

Thunderbolts have always intrigued and frightened mankind. In recent history lightning and thunder have also amazed scientists, who have sensed with their instruments things that totally escape the eye and ear.

There is a small number of scientists working full time on basic lightning research in a few laboratories, including the Westinghouse Research Laboratories. They have gathered a wealth of data, expecially in the last decade, but no one can explain exactly what causes lightning or precisely how it takes place.

Yet lightning is common: 600 flashes occur every second somewhere on the globe. It is economically significant: $100 million in property damage and ten thousand forest fires result from lightning each year in the U.S. And it is dangerous: the Americans it kills every year number in the hundreds.

Lightning can occur in several ways. Most often it happens entirely within a cloud. It can also go from cloud to cloud, and sometimes even appears as the proverbial bolt out of the blue, when there is no cloud around.

But the flash between a thundercloud and the ground is the most commonly seen, and is the case of most interest and importance.

Just before lightning strikes, people in the target area may see hair stand on end and a soft blue gas discharge glow around the tips of pointed objects, even blades of grass, and they may hear a hissing sound. This is known as St. Elmo's fire.

The strike can occur with energy equal to that which would lift the Queen Mary six feet into the air. The eye sees a crooked, forked streak sometimes several miles long. It usually flickers rapidly several times and is over in the wink of an eye — about a fifth of a second or so.

It is usually followed by the claps and rumble of thunder, which usually last for many seconds.

HIGH-SPEED CAMERA

The flash happens so quickly that the unaided human senses can not register all its details. But as other scientists have telescopes and microscopes to enlarge their vision, so the lightning specialist has his instrument — the high-speed camera, which can photograph aspects of lightning that last only as long as a millionth of a second.

The camera reveals that a lightning flash can have several components: stepped leader, ascending streamer and return stroke, usually followed alternately by dart leaders and more return strokes.

The stepped leader is the first stage of the typical flash. A bright streak about 150 feet long and three to thirty feet wide extends from the bottom of the cloud. The streak descends toward the ground by a series of pulsating, jerky steps, each step lasting about 50 millionths of a second.

In its wake, the streak leaves a faintly glowing trace, with forks where other streaks have branched off.

When the stepped leader gets near the ground, streamers of light pop up here and there from the earth striving to meet it.

When one of these streamers contacts the stepped leader, the preliminaries are over and the main event begins — a stream of intense light races from the ground to the cloud along the stepped leader.

Called the return stroke, it starts out at a speed of as much as 100 million miles per hour but slows as it rises. A typical stroke takes something like 70 millionths of a second to reach the cloud.

This may be the end of the flash. But usually about 40 millionths of a second later a 150-foot-long dart of light, called the dart leader, runs down the same path as the return stroke, but avoiding the dead-ends, at a speed of four million miles per hour.

When it hits the ground, another return stroke shoots upward along the dart leader's path. Two more dart-leader and return-stroke combinations occur in the average flash, and as many as 26 have been known to occur. The stroke path also sometimes lights up all at once without another leader or return stroke occurring.

Thus the apparently simple lightning flash is quite complex when examined in detail. Scientists think that faster cameras might reveal an even greater complexity if they could record events happening faster than a millionth of a second.

ELECTRICITY

Other instruments are used to record thunder and the electro-magnetic field, current, temperature and chemistry of lightning.

Data reveal that a thundercloud is positively charge on top and negatively charged on the bottom. This probably results from strong updrafts, falling water and ice particles, and temperature differences within the cloud, although nobody knows for sure.

It is an unstable situation and results in many lightning flashes within the cloud.

Electrostatic forces from the bottom of the thundercloud induce a positive charge in the ground beneath it. This is what causes St. Elmo's fire. One ampere of current at almost a billion volts flows continuously between the average thundercloud and the ground.

Lightning is basically a long spark, a result of static electricity like the sparks that jump from hand to metal in winter.

The stepped leader is a breakdown, or ionization, of the air due to the high voltage. The air is an insulator separating the two highly charged regions of the cloud and the ground; the stepped leader is like a crack developing in this insulator because of the voltage stress.

The typical"crack" is filled with electrons and the atoms from which they have been torn (ions), and with electrons poured into it from the negative bottom of the cloud.

Scientists say that this particle-filled channel, about an inch in diameter, forms the core of the stepped leader, and that the outer portion of the stepped leader is corona discharge from the core. The high voltage of the stepped leader causes the streamers that leap up from the ground to meet it.

When the stepped leader contacts one of these streamers, electrons start pouring out the bottom and electrons all along the channel move down a few feet. This progressive movement of electrons, starting at the bottom of the channel, is what forms the return stroke. After all electrons in the channel have moved down a few feet, and those at the bottom have poured into the ground, the return stroke ends.

Power during the return stroke is not steady, but for a brief instant at its peak can reach a billion kilowatts. This heats the channel to nearly

60,000 degrees Fahrenheit, which is five times hotter than the surface of the sun.

This can set fire to trees, houses and other flammable structures, but not always — if the return stroke lasts less than about 40 millionths of a second, there is not enough time for fire to begin, just as a person can pass his hand so quickly through a flame that he does not get burned.

After the return stroke ends, the "crack" in the air remains and possibly even spreads upward into a higher region of negative charge. When this happens a dart leader descends, greatly increasing the ionization of the channel and filling it with electrons. When it hits the ground another return stroke occurs.

The total amount of electricity discharged by a typical flash is about 350 kilowatt-hours, which would cost a person about $7.00 on his electric bill.

In addition to the general features of lightning, there are details of interest mostly to scientists; the K change, for example, is a small, rapid change in electric field that occurs between and after the strokes of a multiple-stroke flash.

And there are exceptions to many of the processes described for the typical flash;a stepped leader, for instance, can move upward from a tall structure instead of downward from a cloud, and can carry positive instead of negative charge.

Not only do scientists not fully understand the intricacies and exceptions to lightning, but their understanding of the main features is incomplete —nobody knows why the stepped leader is stepped, for example, or why the dart leader is like a dart. And scientists aren't certain of the specific mechanisms by which air breaks down to permit lightning in the first place.

THUNDER

If a person standing close to a lighting flash were not electrocuted, he might still be killed by the explosion of the lightning channel after the flash. Instantaneous heating of the air in the channel may raise its pressure to more than 1500 pounds per square inch, causing it to expand explosively as a shock wave moving at supersonic speed.

The shock wave slows down as it rushes outward, and turns into sound waves of thunder after it has gone thirty feet or so.

The first sound a person hears comes from the part of the lightning channel closest to him. The rumble that follows occurs as sound from successively farther portions of the channel reaches him.

Claps during the rumble come from sections of the channel that are perpendicular to the person's line of sight, so that all sound from a section reaches him at about the same time.

A person can tell how many miles away a flash was by dividing the number of seconds between flash and thunder by 5; sound travels about one-fifth of a mile per second.

Thunder can usually by heard from as far away as 15 miles but normally no farther, because the atmosphere refracts (bends) upward the path of sound. The atmosphere also absorbs high-pitched sound waves, so that the remaining low-pitched sounds account for the deep rumble of distant thunder.

Thunder includes sound waves too low-pitched to hear, and there are reports of lightning occurring without any audible sound at all. Scientists think that this can happen when the stepped leader ascends from a tall structure, instead of descending from a cloud. The current may increase to

its peak value too slowly in this case to cause an explosive shock wave.

In addition to acoustic noise, lightning also produces radio noise, principally in the very low frequencies, that can cause static in radio sets. Westinghouse scientists study the world-wide pattern of lightning-produced radio noise, and its change with time and season, to provide forecasts of communications conditions for global radio systems such as those of the military.

"Whistlers," strange sounds heard on low-frequency radio receivers, are caused by radio waves from lightning that travel along the earth's magnetic lines of force, going out into space and then curving back to earth in the opposite hemisphere; whistlers in the United States come from lightning flashes in South America.

Scientists have suggested that some unexplained radio noise from space may be caused by lightning flashes on other planets.

The electromagnetic field generated by a close lightning flash can cause malfunction of sensitive electronic and computer systems, and can detonate explosive devices.

Other effects of lightning include chemical changes in the atmosphere; many compounds of nitrogen and oxygen form in the lightning channel.

LIGHTNING VARIETIES

Special names have been given to various appearances of lightning:

—Sheet lightning. Clouds light up and thunder is heard but the flash itself isn't seen; due to flashes within or between clouds.

—Heat lightning. A large area of the sky is illuminated with a pale light, but no thunder is heard; caused by bright flashes within clouds or beyond the horizon.

—Rocket lightning. Cloud-to-air flash itself is not seen; due to out the tip winding its way across the sky; occurs when the stepped leader path is so long that there is a perceptible time from beginning to end, and there is no return stroke.

—Ribbon lightning. Ribbons of light appear instead of the usual single streak; presumably caused by high winds blowing in lightning channel sideways, so that the strokes occur in different places.

—Bead or chain lightning. Flashes that appear normal until they break up into long-lasting segments many yards in length; cause unknown, but possible explanations include lightning channels being pinched at points along their length by magnetic forces, or something making portions of the channel wider and hence slower to lose brightness than the rest of the channel.

—Ball lightning. Mysterious, glowing grapefruit-sized globes of light that are sometimes seen drifting near the ground during thunderstorms; unexplained, but speculations include that it may be caused by unusual electromagnetic forces, or that it may be a mass of very hot air combined with soot-like particles resulting from a lightning strike.

LIGHTNING PROTECTION

Lightning arresters protect electrical transmission apparatus by draining into the ground excess currents caused by lightning. They are so designed that they do not drain off normal currents.

The first lightning arrester to give universal lightning protection was the Autovalve arrester invented in 1922 by the internationally known Dr. Joseph Slepian of the Westinghouse Research Laboratories.

Buildings and other facilities are protected by lightning rods, which prevent current from ever reaching the structures. When a thundercloud passes overhead, lightning rods conduct positive charge up above the structure. Attracted by the stepped leader, streamers move upward from the rod and "grab" the leader before it contacts the structure underneath.

Persons can protect themselves from lightning only by getting out of the way. Houses, buildings and automobiles — with windows closed — are quite safe. But small sheds and booths may be unsafe.

Airplanes are good conductors of electricity, and their presence in an atmospheric electric field can trigger lightning. As a result they are often struck — one source estimates that 500 strikes occur every year to commercial jet aircraft in the United States alone — but in most cases there is very little damage.

A person is in danger in the open during a thunderstorm if he is the tallest target, or if he is near an isolated tree, post or mast. A tall wooden object may initially attract lightning, but a person is a better conductor than wood and may provide a more attractive path to ground. Lightning may therefore "flash over" from the object to a nearby person.

Also, lightning may travel a short distance along the surface before it dissipates, and could electrocute a person on the ground or in the water nearby.

Indoors or out, there is some danger near plumbing, wiring, metal fencing, rails and other extended metallic things that could conduct current from the vicinity of a lightning strike.

But even as lethal as lightning can be, two-thirds of people who are shocked by it recover. Physicians say that victims can often be revived even if heartbeat and breathing have stopped, if they are aided quickly enough.

To sum up: lightning is complex, mysterious and dangerous, and Westinghouse scientists and engineers continue seeking to know it, to understand it and to tame it.

<u>SPRING FLING</u> Saturday, ~~Mar.~~ APRIL 27, 8.30 p.m. 420 Wing Club, Airport

Get your tickets at this meeting and avoid the rush. See Bernie, 3ATI and have an inexpensive night dancing with the YL or XYL. %x*#$ which translates to $5.00 per couple or $2.50 each. Come and win a priz3&+#! Darn that printer.

<u>BITS N PIECES</u>

Norm, 3FGH is getting a new tower, Bernie, 3ATI is waiting for a Heath Model 1B-1103 kit to arrive, Ray, 3RP is sure it's the most stable piece of gear yet. Bill, 3EWA has a dipole that doesn't care what you put into it, John, 3FGL is on page 363 or something. The address labels are going to be computerized so we may have some fun. We will try and have the postal codes on them.

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Diagram for the SCR-274 series rcvr - Roy Miller, VE3AAF 942-2247